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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU.

J. G. SMITH, SPECIAL AGENT IN CHARGE.

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CASTOR BEAN.

The Castor bean is of the botanical order *Euphorbiaceae* which includes many well known cultivated plants, such as the potato, tomato and tobacco.

There are many cultural varieties, some of which have been described as separate species, but all intergrade, so that lines of separation between forms can scarcely be distinguished. It is generally considered that all of the different forms or varieties, both wild and cultivated, are derivatives from the single species *Ricinus communis*.

History. The original home of the castor bean plant is a matter of dispute among botanists, some claiming that it is in the Himalayas of northern India; others that it is a native of Abyssinia, and tropical Africa. This plant has been so long in cultivation, that, like Indian corn, its exact native habitat has been lost and is only a matter of conjecture.

The castor oil plant was cultivated in India many centuries before the Christian era, and was well known for its medicinal properties to the ancient Egyptians, Greeks and Romans.

Its seeds have been found in the tombs of the ancient Egyptians, and its characteristics and methods of cultivation have been fully described in classic Roman writings.

It was a well known garden and medical plant in Europe up to the middle of the sixteenth century, but seems to have fallen into complete neglect from that period up to 1764, when Dr. Peter Canavane, a physician who had practised many years in the West Indies published a treatise, strongly recommending its use in medicine. From this date it seems to have grown rapidly in favor among European practitioners, and its use medically and commercially made rapid strides until at the present day it is one of the principal vegetable oils of the world's markets.

The castor oil plant is cultivated on a commercial scale principally in India, three hundred and thirty thousand acres having been devoted to it in that country in 1890. It is also largely cultivated in tropical Africa, Italy, Central and South America, China, and in the United States in Kansas, Oklahoma, Wisconsin, Oregon and California.

Uses of the Oil. Castor oil has many uses. It is used in dyeing with various colors by calico printers; for dressing tanned hides and skins; for the manufacture of Morocco leather; for the preservation of harness; for the manufacture of varnish; and, in India for illumination. It is one of the best lubricating oils for all classes of machinery; is employed for the manufacture of soaps, candles, pomatum, perfumed oils, golden oil, and in fact in a great variety of ways. The stems have been used for the manufacture of paper and charcoal. Indian authorities consider the oil far superior to petroleum or any other mineral oil, or to any vegetable oil, as an illuminant, as it burns with a white light of great brilliancy, without smoke or soot.

The pomace, or cake, remaining after the extraction of the oil from the kernels, is valuable as a fertilizer, and has also been used for the manufacture of an illuminating gas; it is also sometimes used as fuel. New uses are constantly being found for both the oil and the pomace, so that the market is ever ready to absorb whatever quantities of these products may be offered.

Varieties. There are two primary races of the castor bean; one a perennial bushy plant with large seeds, and one with small seeds. The former yields in considerable quantity an inferior oil employed only for illumination and lubrication, or in the various manufactures. The small seeded variety yields a superior oil, the qualities of which constitute it the medicinal oil of commerce.

This plant grows through a very wide range of climates, from the tropics to the north temperate zone, and varies in its size and habit of growth, from a perennial tree thirty or more feet in height, to an annual maturing seed in a very short season and growing only three or four feet in height.

Introduction into Hawaii. The exact date of the introduction of the castor bean plant into Hawaii is unknown, but it may have existed here previous to the advent of the first missionary families. Marin, in his journal, mentions the plant, and refers to its well known medicinal use. Paragraphs relating to it are found in the early records, in the transactions of the Royal Agricultural Society. A number of attempts were made in the early days to introduce its cultivation on a commercial scale and to manufacture the oil, without marked success. The plant has been widely scattered over the islands, and may be seen growing wild by roadsides and in waste places. There are now castor bean plantations on the coastal lands on the windward side of Oahu, and in Kona on Hawaii.

Cultivation. The methods of cultivation vary widely, depending upon the altitude, and whether it is grown as an annual or as a perennial. In this Territory, there is perhaps no time limit to its growth, trees which are known to be from twenty to thirty years old, with trunks sometimes attaining two feet in diameter, existing in various localities.

This crop is suited to cultivation on a variety of soils, but as with most cultivated plants, the best results are obtained on the best land. Although it grows well in forests and in partial shade, the best crops of seed are secured where every portion of the plant is exposed to the bright sun-

shine.

Mr. C. Koelling of Heeia has ex-

perimented with the castor bean for

forcing the production of lateral shoots; these in turn are shortened to compel the plant to branch as much as possible, and also to keep down its height, so that the beans may be harvested from the ground, and to increase the number of seed bearing shoots.

By following this method of pruning, a conical tree is obtained of from eight to ten or twelve feet in height, and with a diameter or spread of from fourteen to twenty-four feet.

The plants commence to flower when they are from eight to nine months old, and ripen the first seed at about ten months from planting.

During the growing period the land should be well cultivated, all weeds kept down and the soil stirred at frequent intervals; the better the cultivation, the better the crop.

The distance apart that the plants should be located will undoubtedly vary in accordance with the altitude at which the castor bean is grown, whether at sea level or at from four to five thousand feet elevation. The plant is extremely susceptible to frosts, and would probably not be cultivated, unless as an annual, above the latter elevation.

The castor bean plant feeds most heavily upon phosphoric acid and potash. In sterile soils, or in soils deficient in these elements low grade fertilizers containing them can be profitably used.

In Kona a crop of beans can be harvested every thirty days, after the plants commence to bear.

The commercial life of the crop, that is the period during which it can be profitably cultivated without replanting, on a good field, ranges from five to seven years, but during this period it must receive frequent cultivation and an occasional dressing of fertilizer, to obtain the best results.

From data obtainable in these islands, the average crop from sea level, up to an altitude of twelve to fifteen hundred feet, ranges from twenty-five hundred to three thousand pounds per acre per annum. Individual trees in the most favored localities, with good soil and cultivation, and a fair amount of rainfall, have been known to yield as high as one hundred pounds of clean seed. However, from twenty to twenty-five pounds per plant is the average yield of clean seed.

The picking or harvesting of the crops is the most expensive operation. The bean must be gathered before completely ripe, because the capsule is explosive, and if the beans are allowed to ripen on the plants, a considerable portion will be lost through the seed-pods bursting and throwing out the seed.

A laborer provided with a basket or sack, cuts off the seed clusters with a hook or sharp knife. These are then placed on a drying floor in the sun, and the pods allowed to crack open and expel the seeds, or the seeds may be beaten out, by hand or by special machinery. The amount which may be gathered by one laborer in a day, depends upon his intelligence and skill. The shelled beans free from the husks or seed pods are marketable without further preparation. There is a ready market for castor beans in Honolulu, or they may be packed and shipped to San Francisco or other eastern markets.

Extraction of the Oil. The process of manufacture of the oil is quite complicated, and it does not pay the cultivator to attempt, by himself, to extract the oil.

The current prices for castor beans of good quality range from \$50.00 to \$60.00 per ton in the Honolulu market; a price sufficient to yield a margin of profit both to the cultivator and to the manufacturer of the oil.

Castor Pomace. The residue remaining after extraction of the oil from the castor bean is itself a product of some value for fertilizer. Analyses of this substance show that the castor pomace contains on an average about 5 per cent nitrogen, 2 per cent phosphoric acid and 1 per cent potash. The seed pods and pod stems contain about 2.5 per cent nitrogen and 6.5 per cent potash.

At the Connecticut Experiment Station trials of castor pomace have been made during a series of years since 1892, and the fertilizing value of the nitrogen has been determined to be about 75 per cent that of nitrogen in the form of nitrate of soda. At the current market price of fertilizers in this market, castor pomace of average composition should be worth about thirteen dollars per ton on account of the nitrogen, phosphoric acid and potash which it contains. Furthermore this pomace is more valuable than some chemical fertilizers in that the nitrogen which it contains is gradually available. The pomace is more valuable for fertilizer than for fuel, a use to which it is largely put in India. It should find ready sale in the local markets.

Conclusion. The castor bean is a crop of some promise for cultivation by men of small means and although the yields per acre are moderate, perhaps seldom exceeding \$75 to \$80 gross income per annum and sometimes not exceeding half of that, the castor bean is a readily salable article, if not in the local markets, always in those of San Francisco, or other large markets.

It is a crop which up to the present time has very few enemies in this country, and a particular advantage is that the product does not readily deteriorate if properly cared for after harvesting. With average yields of from two thousand to three thousand pounds per acre, and with a crop which does not require replanting, except after a period of from five to seven years, the outlook is a very promising one.

Some very serious insect pests occur in India and tropical Australia, and steps should be taken to prevent these gaining admission to this country. Some of these which are leaf-eaters, with habits somewhat similar to the Japanese beetle, often completely strip castor bean foliage in large areas of castor bean plants.

While the cultivation of this crop is not large which would pay investments of large amounts of capital, yet it seems to be well suited to small landholders who can use their own labor, or that of their families, and do not have to employ J. G. SMITH.

25. Oklahoma Experiment Station Bul.

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